All About Amphibians

Introduction

Kermit the Frog was right when he said, "it's not easy being green," especially today in the face of largely unexplained global amphibian declines. Little is known about amphibian populations in Alaska because scientists have only just begun studying them, although long time residents report far fewer animals today than when they were young.

Amphibians at home and around the world need your help. By participating in this curriculum, you and your students will learn about amphibians and their unique and amazing biology, behavior and habitat needs, along with their colorful role in myths, folklore and literature. You may also collect important data and natural history observations herpetologists can use in understanding what's happening to amphibians here at home.

In this section, you and your students will learn many of the big important ideas about frogs and salamanders. You'll learn about their ability to glide through the air to escape predators, throw up not just their stomach contents, but their entire stomach when a certain food disagrees with them, and how some frogs can freeze solid for months and not croak (sorry we couldn't resist). You will find out how they help humans and why they are an important part of the biodiversity of life on this planet.

These introductory pages are designed for both teachers and students to read and discuss in order to build general knowledge and background information for the other lessons in this curriculum. There are three sections to the reading material, 1. All About Amphibians, which includes Big Important Ideas; 2. Fun Frog Facts; and 3. Amphibians in Alaska. Three activities that reinforce the information that is presented in the reading material are included at the end of the section.

National Science Education Standards:

Content Standard C:

- Develop understanding of diversity and adaptations of organisms

Alaska Content Standards:

Science C(2)

Juneau School District Core Content:

Life and Human Biology (6th-8th):

Patterns of Change: How does understanding the patterns of change allow us to interpret the world?

- Show the life cycle of an organism
- Share how life forms change over time

Extensions:

After students have a chance to read the section, try these ACTIVITIES to reinforce the Big, Important Ideas!

1. Encourage students to complete Frog Life Cycle or Frog Cartoon worksheets.

2. Check out the Build a Frog / Salamander Box Activity to learn about amphibians' amazing adaptations by turning one of your students into a frog or salamander.

3. Encourage students to pick an amphibian to create out of paper maché. Design natural habitats in which to place their amphibians, and display creations around your classroom or school.

4. Learn about amphibians' contributions to medicine by researching how chemical compounds from several frog species are used to create antibiotics and analgesics. Or, how research into salamander limb regeneration may lead to therapies for people who have lost limbs through accidents or birth defects.

References:

Corkran, Charlotte C. and Thomas, Chris. Amphibians of Oregon, Washington and Bristish Columbia. Vancouver: Lone Pine Publishing, 1996.

Environment Canada. Frogs, Toads & Salamanders. Amphibians of the Yukon and Northern British Columbia.

Frog Life Pack. 2002. KESAB Patawalonga and Torrens Waterwatch. 16 March 2004 <http://www.cwmb.sa.gov.au/kwc/section3/frog_pack_2003.pdf>.

"Frog"-quently Asked Questions (FAQ's). 1999. A Thousand Friends of Frogs. Hamline University Graduate School of Education. Center for Global Environmental Education. 16 March 2004 <http://cgee.hamline.edu/frogs/science/faq1.html>.

Hermans, Marge and Bob Armstrong. "Newts in the Rain Forest."Alaskan Southeaster. Nov. 2001: 13-17.

Hermans, Marge and Bob Armstrong. "Toads in Southeast Alaska." Alaskan Southeaster. Sept. 2000: 26-28.

Kennedy, Marylou. "How Do Frogs Survive Winter?" SCIENTIFICAMERICAN.com 24 November 1997. 16 March 2004 <http://www.sciam.com/askexpert_question.cfm?articleID=0009018D-6EDB-1C72-9EB7809EC588F2D7>.

MacDonald, S.O. Amphibians and Reptiles of Alaska: A Field Book. US Fish & Wildlife Service: April 2003. 16 March 2004 <http://usgovinfo.about.com/gi/dynamic/offsite.htm?site=http://alaskaherps.info>.

The Somewhat Amusing World of Frogs. 16 March 2004 <http://www2.tltc.ttu.edu/thomas/classPet/1998/frog/ABOUTfrog.htm>.

All About Amphibians

"It's not easy being green."
Kermit the Frog

So, why should YOU study amphibians? Good question – especially since you could live your whole life in southeast Alaska without ever seeing one! Here are a few good reasons:

1. **Amphibians are part of the earth's biodiversity.**

Bio means life, and diversity, variety. Put it together and biodiversity is the amazing and rich variety of life around us, from the most microscopic bacteria to the biggest blue whale. And although no one knows just how many different plant or animal species exist on earth – the most common estimate runs between are in the 10-15 million – we do know that biodiversity is essential to the health of the planet we all call home.

Why? Because we never know when a plant or animal may hold the key to a medical mystery, a new food source or an important industrial product. For example, plants found in a tropical rainforest may hold the cure for cancer; slimy marine worms may contain chemical compounds with healing properties; overlooked microbes may have the ability to neutralize toxic water. Amphibians are already used to make medicines – the glands of some frog species contain 20-30 chemical compounds currently used to produce antibiotics and analgesics or painkillers, one of which is 200 times stronger than morphine. Medicines made from frogs may also hold the key to potential new treatments for schizophrenia.

But, biodiversity is more than just numbers. Understanding and protecting biodiversity means understanding not just how many plants and animals exist on earth, but how they relate to one another. It's the connections, relationships and interactions between the world's many species that drive the processes that make life possible. And amphibians are part of the earth's biodiversity.

2. **Amphibian populations are declining drastically around the world.**

Many amphibian species are experiencing drastic declines. Some have even recently gone extinct. Declines continue to puzzle herpetologists – scientists that study amphibians and reptiles – because they seem to be taking place in pristine wilderness areas or protected national parks, as well as more developed areas like cities and suburbs. Herpetologists suspect a number of causes, including pollution from fertilizers and pesticides, destruction of wetlands and other habitats, introduction of non-native species, increased ultraviolet radiation, and parasites. Though no one understands exactly what's going on, many researchers believe these things might be working together to cause global amphibian declines.

3. **Amphibians are like canaries in the coal mine.**

Amphibians are thought to be bio-indicators – organisms that tell us something about the health of their environment. For example, frogs are well known for their sensitivity to pollution and habitat degradation. They need healthy aquatic and terrestrial environments to complete their life cycles from egg to tadpole to adult. As bio-indicators, amphibians may be like canaries in a coal

mine. Could their declining populations be telling us something about the environments in which we find them? And what do these changes mean for other species, including us humans?

4. Amphibians in Alaska may be declining too.

Although researchers suspect amphibians in Alaska are also on the decline, little is known because we've only begun to study them. By participating in this curriculum, you and your students will not only learn about amphibian populations worldwide and here at home, but you can help generate important data and natural history information that herpetologists can use to learn more about the health of local populations.

To get started on your study of amphibians, you'll need to understand some BIG, IMPORTANT IDEAS ABOUT AMPHIBIANS. Keep reading to learn more!

Big, important ideas about amphibians

1. Frogs, toads, salamanders and newts belong to the class of animals called *amphibians*.

Amphibians differ from reptiles because they lack scales and generally return to water to breed. The word amphibian comes from the Greek words *amphi* and *bios* and means double life – probably a reflection of the fact they live both in water and on land.

Amphibians are a diverse group, with lots of physical variation. West Africa is home to the world's largest frog. Named the Goliath, this species grows to a length of 37 cm (over a foot long!) and can weigh as much as 3.7 kg (over seven pounds and the weight of an average housecat!).

The smallest known frog species found in the northern hemisphere lives in Cuba (*Eleutherodactylus iberia*). Discovered in 1996, this frog has yet to receive a common name! The Brazilian Golden Frog (*Psyllophryne dudactyla*) is the smallest species in the Southern Hemisphere. As adults, both species grow no more than 1 cm long, much smaller than the length of their scientific names! Here in North America, the smallest species is the Little Grass Frog, a species that averages 3 cm in length.

Amphibians can change color depending on light levels, moisture, temperature stress level and the color of the background in which they find themselves. For example, most frogs and toads look much darker during cold conditions and much lighter when it's warm and dry. These changes are determined by color-containing cells within the skin.

Many amphibians have another amazing ability – they regenerate lost tails or limbs. For example, if a predator catches a fleeing salamander by the tail, all or part of its tail can break off, allowing the salamander to escape by distracting the predator with its tail, which can sometimes continues to wiggle! The tail stump starts to regenerate and can be full length again in just a few months. In many species, tails are more brightly colored than their bodies, helping focus predators' attention on a body part animals can live without.

While most salamanders can regenerate lost limbs, closely related frogs cannot. By understanding this mystery, researchers hope to develop new ways to help humans who have lost limbs due to accidents or birth defects.

2. Frogs and toads are easy to tell apart.

Frogs and toads are anurans – one of the three orders of amphibians. Both share some features, but differ in others, like body form and habitat needs.

True frogs have:

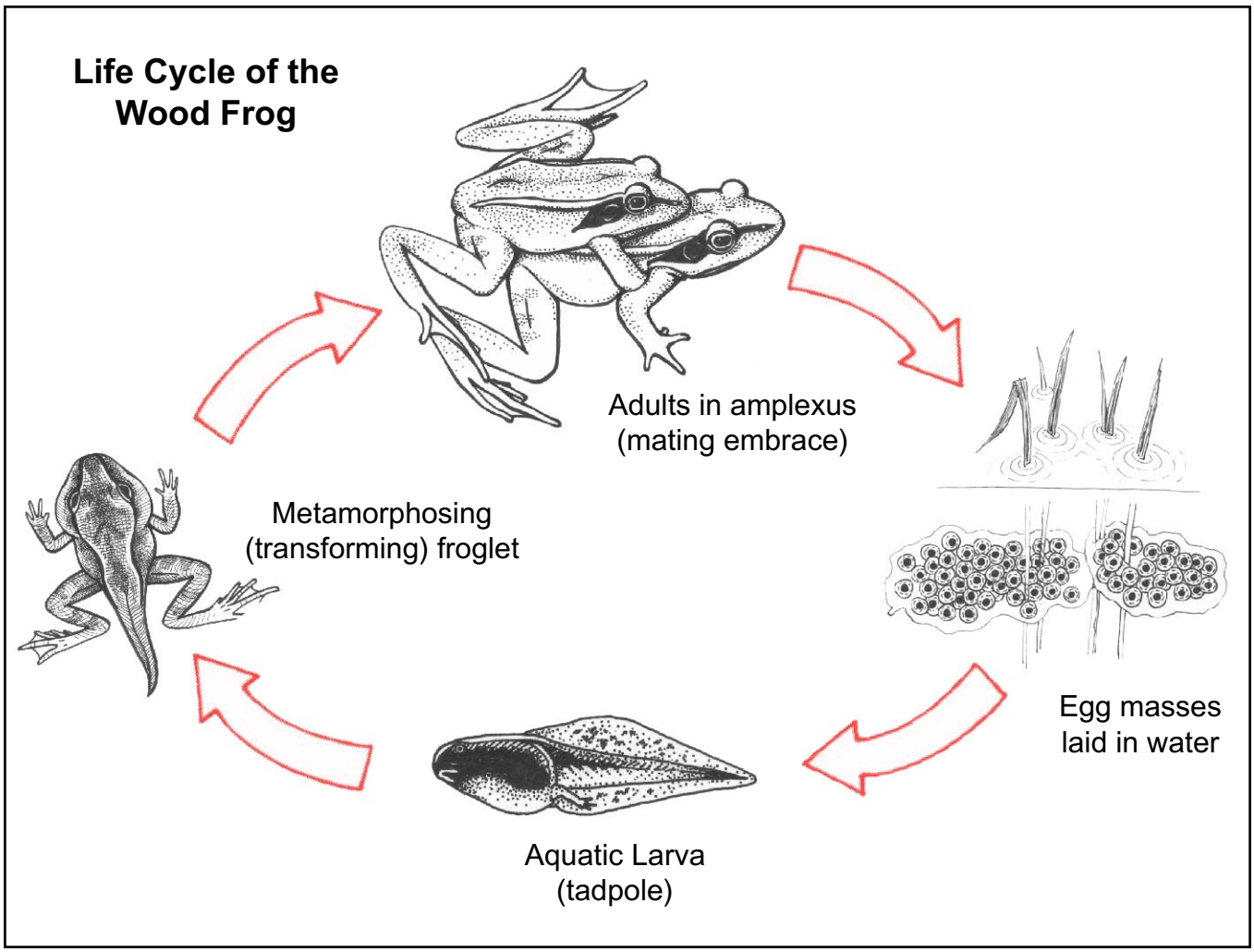
- Two bulging eyes.
- Strong, long webbed hind feet adapted for leaping and swimming.
- Smooth or slimy skin.
- Eggs laid in clusters.

True toads have:

- Stubby bodies with short hind legs adapted for walking, not hopping.
- Dry, warty skin.
- Paratoid or poison glands behind eyes.
- Eggs laid in long chains.

3. Amphibians need both aquatic and terrestrial habitats to complete their life cycles from egg to tadpole to adult.

Amphibians depend on both aquatic and terrestrial habitats to complete their life cycles. For example, land-dwelling adult frogs return to breeding ponds or puddles to lay soft, jelly-like eggs in water. This diagram of the life cycle of a frog has been taken from Amphibians of Alaska: A Field Handbook (S.O. MacDonald. Juneau, Alaska: USFWS, 2003).

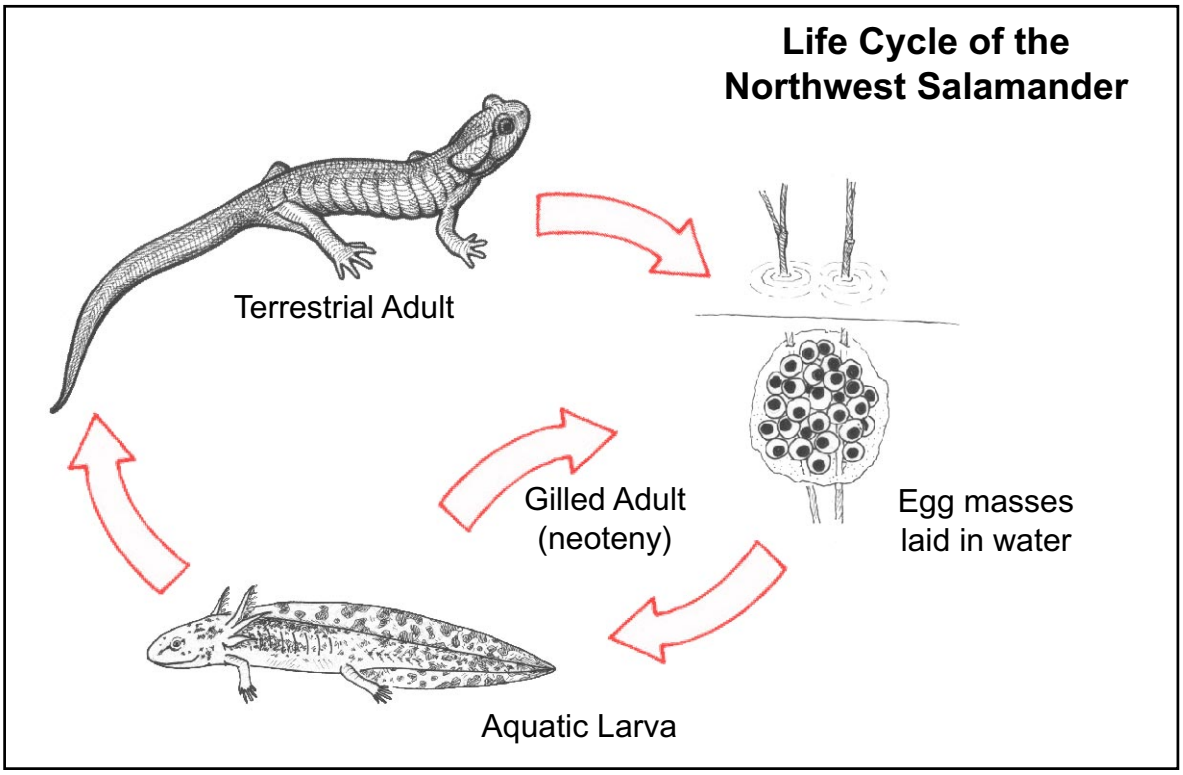


When frogs and toads reproduce, males climb onto females' backs and squeeze. In response to this stimulation, females release as many as 200 eggs which the male then fertilizes. The embryos are surrounded with a sticky transparent jelly that attaches the egg mass to underwater plants and feeds the developing embryos. Frog larvae – or fish-like tadpoles – live in water, using tails to swim and gills to breathe. Tadpoles become adults in a process called ***metamorphosis***. They trade in tails and gills for legs and lungs and move onto dry land.

Even after they move on land, adult frogs spend most of their lives near ponds or streams, and adult toads often live in moist woods. Both are specially adapted to breathe and drink through their skin! Unlike humans, frogs and toads absorb much of the moisture and some of the oxygen they need directly through their permeable skin through the process of ***osmosis***. Frogs take care of their skin by keeping it moist and shedding regularly. That's the reason they so often look slimy.

Toads are better adapted to life on dry land than frogs because their warty skin helps conserve water. Some toads live in remarkably dry places and adapt by burrowing deep into moist soil and pressing their skin against the walls of the burrow. Their permeable skin functions like the root hairs of plants – osmotic pressure moves water from the soil and into the toad through its skin!

Salamanders need moist habitat too. This diagram of a salamander's life cycle has been taken from Amphibians and Reptiles of Alaska: A Field Handbook (S.O. MacDonald. Juneau, Alaska: USFWS, 2003).



Unlike toads and frogs, salamanders do not call to attract mates. Instead they search them out by smell. Salamanders breed in permanent ponds. Mating adults lay egg masses in water which are often attached to stems or sticks. The young hatch as aquatic larvae. Some hatchlings have ***balancers*** – whisker-like appendages on either side of the head that provide a stable support before front legs develop several weeks later.

In most species, gills and tailfins are reabsorbed during metamorphosis as larvae become terrestrial adults that live under rocks or logs. But unlike toads and frogs, some salamander larvae do not undergo full metamorphosis – they never leave the water but become adults that retain gills. These salamanders have a special name – ***neotenic larvae***. Some scientists believe ***neoteny*** may be a response to the dangers of life on land.

4. Amphibians are an important part of the food web.

Most amphibians are ***generalists*** that will eat anything they can fit into their mouths! Tadpoles are filter feeders that eat tiny bits of floating plants and bits of organic matter. They also graze algae by using the tiny teeth on their lower jaws. Tadpoles' long, coiled intestines help break down hard to digest plant food, which is important because they need to grow quickly enough to avoid starvation or death as their puddles dry out.

Adult amphibians are mostly carnivorous. Large adults – like bullfrogs – eat mice, small fish, ducklings, snakes or other amphibians. And while salamanders can only snap their jaws open and shut to catch prey, many frogs use their long, sticky tongues to catch insects. Frogs and toads eat lots of insects, which helps keep bug populations in check.

Some frogs have an amazing adaptation that allows them to eject stomach contents if they eat something poisonous or bad for them! When they do this, their stomachs protrude from their mouth and they wipe contents away with their right front leg. Why the right and not the left? Frogs' stomachs are located slightly more toward their left sides – when the stomach ejects, it pulls to the right because the membranes holding it in place are shorter on that side. The right front leg can reach the stomach while the left can't, so frogs use their right legs to get rid of whatever's bothering them.

Amphibians, in turn, make a tasty meal for many of the critters with whom they share their habitats. Dragonfly nymphs, fish, snakes, river otters, herons and other birds all eat amphibians at various life stages. Tadpoles even eat one another when food supplies run low. Even we humans eat frog legs. Predators might seem to be a major problem for these clawless, soft-skinned critters, but amphibians have adapted all sorts of protective powers.

Some amphibians hide or change color to camouflage themselves. Others leap away on strong powerful legs. Still others produce toxic or bitter chemicals secreted in the mucous coating on their skin, making them distasteful or deadly to predators. For example, the marine toad (*Bufora marinus*) squirts toxins from glands behind its head. Able to reach predators up to one meter away, toxins blind or injure predators, allowing the toad to escape. South American poison arrow frogs (*Dendrobates azureus*) make a toxin so powerful it can kill humans and other large animals, and get their common name from the native use of this poison on arrowheads and darts. One such toxin is so potent, as little as 0.00001 grams can kill an adult human! The more toxic amphibians usually wear bright colors, warning potential predators to stay away.

Rough skin newts – a species common in southeast Alaska – are among the most poisonous animals in the world! They secrete ***tetrodotoxin*** (TTX) – one of the strongest nerve poisons around – from specially adapted skin glands. Most predators foolish enough to swallow a newt would probably die well before the newt itself did!

5. Amphibians have adapted amazing survival techniques.

Amphibians are cold blooded, or ***endothermic***. They can't generate enough heat to warm their own bodies, and rely on the temperatures around them to keep them warm or cool enough to survive. Even so, we find amphibians in some of the most extreme climates on earth – at the Arctic Circle, in deserts, tropical rainforests and everywhere in between. These cold blooded critters have adapted to deal with extreme climates in a number of amazing ways.

Hibernation is a common response to cold winters in temperate climates. Once a frog finds or makes a living space – a ***hibernaculum*** – to protect itself from winter weather and predators, its metabolism slows and it sleeps away the winter by using energy stored in its body. When warmer weather arrives, frogs wake up, leave their hibernaculum, and get on with the business of feeding and breeding.

Aquatic frogs like the leopard frog (*Rana pipiens*) and the American bullfrog (*Rana catesbeiana*) typically hibernate underwater. But, they don't dig into the muddy bottom like hibernating turtles. If they did, they would suffocate. While a hibernating turtle's metabolism slows down enough to allow it to get by on the mud's meager oxygen supply, hibernating frogs must be near oxygen-rich water and spend much of the winter lying on top of the mud or only partially buried. They may even swim around slowly from time to time.

Terrestrial frogs usually hibernate on land and are often good diggers. For example, American toads (*Bufo americanus*) burrow deep into the soil, safely below the frost line. Poor diggers, like the wood frog (*Rana sylvatica*) and the spring peeper (*Hyla crucifer*), look for deep cracks and crevices in logs or rocks instead or dig down as far as they can in softer leaf litter. Because they are not as well protected as their digging cousins, they may freeze in extreme winters.

The may freeze, but they don't die. Why? Antifreeze! Even though ice crystals might form in the body cavity and bladder, or under its skin, a high concentration of glucose – or sugar – in frogs' vital organs prevents them from freezing to death. Partially frozen frogs look dead – their hearts stop beating and they no longer breathe – but warm up their burrows and frozen parts thaw, hearts and lungs start working and frogs survive!

While hibernation is a response to long, cold winters, ***torpor*** is an adaptation to short-term cold snaps. Torpor is characterized by the lack of mental activity and movement – an extreme sluggishness that's short of the total metabolic slowdown of hibernation. Yet another adaptation, ***diurnation*** allows frogs to go into short-term torpor on cold nights, allowing them to conserve energy and be more active during warmer daytime temperatures. And finally, similar to hibernation, ***estivation*** is a dormant state that allows frogs to survive environmental conditions like the prolonged dry season of certain tropical regions. Two well-known estivators are the South American ornate horned frog (*Ceratophrys ornata*) and the African bullfrog (*Pyxicephalus adspersus*).

At the start of the dry season, these frogs burrow into soil and become dormant. During the long dry season – which can last several months – these frogs shed several intact layers of skin, forming a virtually waterproof cocoon that envelopes their entire body, leaving only the nostrils exposed so they can breathe. African bullfrogs can survive this way for up to seven years! They free themselves when the rains return and make a convenient first meal out of their cocoons!

Fun Frog Facts

Amphibians are amazing, interesting, important and worth learning about, even if you never see one in your backyard. Check out these **Fun Frog Facts**....

DID YOU KNOW THAT:

- **A frog's eyeballs actually turn inside out when it eats?**

When a frog swallows a meal, its bulging eyeballs close and move down into its head to apply pressure that helps push the meal down its throat.

- **Frogs have teeth?**

Although they're different from ours, most frogs have teeth on their upper jaws and on the roofs of their mouths. Teeth found on the upper jaw are called maxillary teeth, and teeth on the roof of the mouth, volmerine teeth. Because frogs swallow their food whole, these teeth are not used for chewing, but for holding prey in place till eyeballs help push it down their throats.

- **Frogs can be hypnotized?**

Try hypnotizing a frog by laying it on its back and gently stroking its stomach!

- **Chile's small Darwin's frog (*Rhinoderma darwini*) nurtures its young in a unique way?**

After the female lays about 30 eggs, the male guards them for two weeks and then swallows the survivors. Offspring develop in the male's vocal pouch until they can survive on their own and hop out!

- **Frogs are really, really good jumpers?**

Frogs have amazingly strong and long legs that allow them to leap away from predators in no time. Frogs are well known as some of the best leapers of all living creatures. They can launch themselves over 20 times their own length! That would be like YOU jumping 33 yards, or almost 100 feet in one leap!

Amphibians in Alaska

Two of the three orders of amphibians are found in Alaska – **Anuran** or without a tail, and **Caudate** or with a tail. The third order – **Caecilian** – includes legless, worm-like amphibians found only in the tropics. Frogs and toads belong to the order, Anuran, while newts and salamanders belong to the order Caudate.

The spotted frog, Western toad, northwestern and long-toed salamanders, and rough-skinned newt all prefer the mild, wet climate of southeast Alaska, while the wood frog is found all over the state, from southeast Alaska to north of the Brooks Range!

In addition to these six species, localized populations of Pacific chorus frogs have been found near Ketchikan and red-legged frogs have been found on Chichagof Island. These species do not occur here naturally and may well have been former pets that managed to reproduce after being released or escaping.

The section below has been adapted from an excellent field handbook – Amphibians and Reptiles of Alaska: A Field Handbook (S.O. MacDonald, Juneau, Alaska: USFWS, 2003). It is an excellent reference for additional information, including descriptions and pictures of frogs, toads, salamanders, newts, their eggs and larvae.

WESTERN TOAD (*Bufo boreas*)

- Bufo: toad
- boreas: north wind

Originally called the boreal toad, and still sometimes referred to this way, this species is found on the mainland, on islands in southeast Alaska and northward along the Gulf Coast to Prince William Sound. Primarily land dwellers, toads use ponds, lakes and slow moving rivers to breed. They are active during the day, especially in sunny, warm, damp weather, and are good diggers that hibernate in burrows dug below the frost line in forested areas adjacent to wetlands. Groups of toads often hibernate together. In Juneau, toads have been found breeding in North Douglas, on the Mendenhall State Game Refuge and in Cowee Creek Meadows.

Female Western toads tend to be bigger, blotchier and rougher skinned than males. When handled, toads twitter, grumble, urinate, secrete a bitter poison from skin glands or puff themselves up to look bigger. And unlike frogs, Western toads can tolerate brackish water and are capable of swimming for several hours in saltwater! This may explain why toads are found on most of the coastal islands.

In many parts of their range – including pristine environments – Western toad populations seem to be declining rapidly for reasons that continue to be a mystery. Researchers suspect declines in Alaskan populations as well, based in part on the observations of long-time residents from Haines to Ketchikan.

WOOD FROG (*Rana sylvatica*)

- Rana: frog
- sylvatica: growing among trees

Found throughout North America, the wood frog is the only amphibian found north of the Arctic Circle. The wood frog is documented all over Alaska except for Prince William Sound. Although they are more common in central and interior Alaska than in Southeast, eggs and frogs have both been found on Douglas Island.

Wood frogs do well in the colder, northern parts of Alaska because they grow quickly, changing from egg to tadpole to adult before water freezes in the fall. Even so, Alaskan wood frogs are noted for amazing adaptations that counterparts in the lower 48 haven't had to make.

Like other amphibians living in cool climates, the wood frog hibernates each winter. But, unlike its warmer weather relatives, Alaskan wood frogs also freeze! As they drift into deep sleep, their hearts and breathing stop and most of the water in their bodies turns to ice. When warmer weather returns, wood frogs slowly thaw with hearts beating and lungs breathing. How can this be?

The secret to their survival in cold temperatures is slow, sweet super-cooling. Super-cooling allows wood frogs to rid body fluids of impurities that would otherwise trigger the formation of ice, and allows them to cool well below 32 degrees Fahrenheit without having ice crystal puncture cell walls.

Super-cooling works because it's slow and because wood frogs become sweet. Slow cooling allows the water inside a frog's body to shift position. If water collects in hollow cavities – like the stomach – it has more room to expand as it freezes. But if too much water remains in its organs, blood vessels will rupture as temperatures drop and frogs die during hibernation.

As temperatures drop below freezing, wood frogs' eyeballs and other extremities begin to freeze, sending a message to their livers to start converting glycogen to sugary glucose. Just like the antifreeze in your car, glucose lowers the freezing point of water, and protects frogs' organs as it's circulated throughout the bloodstream. As glucose flows into vital cells, it also helps them resist dehydration, which can lead to frostbite in human flesh.

Even with this amazing adaptation, wood frogs need to eat as much as they can each fall to store up energy vital to hibernation. When it turns cold and insects become scarce, wood frogs often turn into cannibals, eating their own offspring! Sometimes, it really isn't easy being green.

COLUMBIA SPOTTED FROG (*Rana luteiventris*)

- Rana: frog
- luteiventris: golden-yellow belly

Spotted frogs are found along the mainland rivers of Southeast Alaska, including the Salmon, Unuk, Stikine and Taku. Other locations include Haines and Mitkof Island near Petersburg. In Juneau, spotted frogs have been found at the Community Gardens in Montana Creek, where they were heard calling loudly.

Known for their short, low pitched and quiet grunts and drones, spotted frogs prefer areas with permanent water – beaver ponds, river channels and streams. They use these areas to breed, hunt food and hibernate on or in mud and under streambanks.

PACIFIC CHORUS FROG (*Pseudacris regilla*)

- Pseudacris: false locust
- regilla: regal or splendid

Formerly and sometimes still called the Pacific tree frog, its call sounds like that of a cricket or locust – something like "wreck it" or "kreck eck." A group of males is called a chorus. Once a dominant male or chorus leader, starts the call, other males soon follow, repeating it throughout the night and some parts of the day during mating season. Pacific chorus frogs also make a more traditional "ribbit" call, along with choruses of loud, short, high pitched trills. Their calls are often louder and last longer than other frogs. Recordings of their calls often provide the soundtrack for movies requiring frog sounds – watch a movie with a jungle scene and you'll most likely be listening to the calls of Pacific chorus frogs!

Mostly a ground dweller, this frog inhabits a wide variety of vegetation from grasslands to wooded forest. Usually found in low vegetation close to water, Pacific chorus frogs can be found far from water since glands on their skin can produce a waxy coating that prevents dehydration and provides a convenient snack when it's no longer necessary.

Not native to Alaska, this frog was introduced to a group of muskeg ponds near Ward Lake, near Ketchikan. Introduced around 1960, the population has not spread from this area. Interestingly enough, two amphibian researchers found one Pacific chorus frog on Moraine Way, here in Juneau. After photographing it, they released it. How do you think it got here?

RED-LEGGED FROG (*Rana aurora*)

- Rana: frog
- aurora: dawn

These frogs are found all over western North America – from southwestern British Columbia to southern California. Habitat loss has been primarily responsible for red legged frog declines in Oregon and California. Although they are not native to Alaska, red legged frogs have been found on northeast Chichagof Island near Hoonah, and were believed to have been released in 1982 or 1983 by a schoolteacher from the Freshwater Bay logging camp. Although none have been reported in Juneau, they may very well exist.

NORTHWESTERN SALAMANDER (*Ambystoma gracile*)

- Ambystoma: blunt mouth
- gracile: slender or simple

Because this species is typically chunky, gracile probably refers to the simple or plain color pattern of the adult. This species has been collected in only two locations in Southeast Alaska – southeast of Ketchikan on Mary Island, and on Chichagof Island near Pelican.

Adults live underground and are usually active on the surface only during rains and migrations to aquatic breeding sites, which include muskeg ponds and freshwater lakes. Adults lay eggs in a firm, jelly-like mass that resembles a grapefruit and is attached to underwater to sticks and stems. Larvae may need two years to complete metamorphosis so breeding sites must stay wet. However, some larvae never go ashore, but remain aquatic as gilled adults in a process called neoteny. Populations of neotenic salamanders have been found in coastal British Columbia, and although close to Alaska, none have been found in populations here.

When threatened, this species lifts its back up and tips its snout down to present its poison glands to its attackers. And although its poison is not especially toxic, the large white drops that ooze out and run down its sides make it appear threatening enough!

LONG-TOED SALAMANDER (*Ambystoma macrodactylum*)

- Ambystoma: blunt mouth
- macrodactylum: long toe

This species' Latin name refers to its long fourth toes on its hind feet. Found all over northwestern North America, this species has been subject to deformities and die-offs. However, it may be the most versatile of all Pacific Northwest amphibians and is found in wet coastal forests, cold mountain meadows as well as a variety of dry habitats. Though relatively common in its range, little is known about the occurrence of this species in southeast Alaska. Individuals have been found along the

major river systems including the Stikine and Taku, and in the Taku River valley.

Long-toed salamanders are nocturnal and spend most of their time underground. Adults are often found under rocks or decaying logs. In winter, long-toed salamanders have been found hibernating in groups below the frostline.

When threatened, this species behaves much like the Northwestern salamander – its raises it back, lowers it head and secretes a sticky white substance from its tail as it waves about.

ROUGH-SKINNED NEWT (*Taricha granulosa*)

- Taricha: a preserved mummy
- granulosa: full of small grains

This species most likely gets its name from its grainy skin. Rough-skinned newts occur on mainland Southeast Alaska as far north as Juneau, on Admiralty and Shelter Islands and on many of the islands south of Frederick Sound. Rough-skinned newts have also been spotted on Bamdoroshni Island in Sitka Sound – these were probably transplanted in the 1980s from animals around Ketchikan. Juneau newts may well be transplants as well, arriving in the 1960s from Shelter Island populations.

Rough-skinned newts live in forested and partially wooded areas and are the most common tailed amphibians in Alaska. Juveniles and adults live in or under soft or rotting logs and are active on the forest floor during damp conditions, even during the day. The skin of juveniles and adults is dark brown and grainy in appearance while undersides are bright yellow-orange. Some newts live in ponds even as adults. Compared to land dwelling relatives, aquatic newts have smoother skin, paler skin tones and undersides that are gray or cream colored instead of bright yellow-orange. Aquatic adults sometimes look puffy, as if they stayed in a tub too long.

Newts produce the most toxic poison of any Alaskan amphibian, and are among the most poisonous animals in the world! Glands in their skin produce tetrodotoxin – or TTX – a compound 10-100 times more lethal than black widow spider venom and over 10,000 times as lethal as cyanide! According to some studies, one adult newt can produce enough TTX to kill seven people! A defense against predators like jays, herons, owls, fish, minks and snakes, newts seldom release this toxin – their bright color usually warns predators to stay away. When threatened, rough-skinned newts thrust their heads and tails up to show off a brightly colored underside.

Draw Your Own Frog Lifecycle

Imagine you are frog spawn beginning your life cycle, and you go from spawn to frog. Draw the stages of your lifecycle and describe each state and how it might feel.

Create Your Own Frog Cartoon

In the boxes below draw your favorite frog. Remember to use the correct colors and include features such as toes and eyes. Then, using your frog as the main character, create a cartoon illustrating your thoughts about:

- Where frogs live
- What frogs do
- What frogs look like
- How frogs move

The Star Character

Build a Frog / Salamander Box

You can help students understand the amazing and unique adaptations that frogs and salamanders have by dressing a student up as an amphibian! Some unique characteristics are listed below as well as common household items you can use to represent them.

These are just suggestions. It would be more fun to have your students work in pairs or groups to identify important amphibian characteristics themselves, decide what items to use and then present their dressed-up "frogs or salamanders" to the class.

1. Frogs have AMAZING EYES. Their eyeballs turn inside out to help push food down their throats. Also have a transparent nictitating membrane which protects the eye and cleans it. **Goofy eyeball glasses attached to a slinky. You can buy these in toy stores.**

2. Frogs hear using big round ears on the side of their heads called TYMPANUM or tympanic membranes. Tympanum means drum. The Tympanum or ear drum receives sound waves and covers the ear canal. **Bright colored ear muffs illustrate this well.**

3. Amphibians have SEMI-PERMEABLE SKIN and they breath and drink by absorbing water and oxygen through their skin. Tiny pores in their skin allow H2O and O2 molecules through. **We have used a mesh sports penny or coffee filters taped to t-shirt.**

Use a fanny pack or back pack to hold the following items:

4. Scientists are discovering that amphibians' SKIN contains chemicals which act as ANALGESICS (PAINKILLERS) AND ANTIBIOTICS. In fact, some amphibians are just walking chemical factories! These may be very beneficial to people. **A bottle of Tylenol and a tube of antibiotic cream can be used.**

5. Amphibians' skin contains MUCOUS GLANDS which help keep them and their skin moist. **A bottle of skin moisturizer can illustrate this.**

6. The skin of amphibians also contains POISON GLANDS. Rough-skinned newts contain a chemical that is one of the most toxic substances known. Most of these toxins aren't strong enough to harm people, but stronger poisons can cause muscle spasms, heartbeat irregularities and breathing trouble. So wash your hands after you handle an amphibian and don't' touch your eyes or mouth before you wash. **To make a poison bottle label an empty plastic bottle with skull & crossbones, or the green Mr. Yuck symbol.**

7. Amphibians have strong WEBBED FEET that help them swim and in some species act as parachutes to help them escape predation. **A pair of diver's fins will do nicely for this.**

8. Amphibians have THREE-CHAMBERED HEARTS as opposed to our four-chambered ones. It's more efficient than two-chambered heart of tadpole or fish, but less efficient than four-chambered heart of warm-blooded animals. The three chambers of a frog's heart are right atrium, left atrium and ventricle. The blood returning from the body full of carbon dioxide is pumped by the same chamber as oxygen rich blood coming from the lungs. This means that blood going to the body has carbon dioxide diluting the oxygen. **Draw a three –chambered heart on a piece of cardboard, cut it out, and stick it on the kid's chest.**

9. Salamanders have BRIGHTLY COLORED TAILS. We made one out of brightly colored material and it's so pretty that we want to make the whole animal! However, a **felt or cardboard tail** will do also. Hand it to the kid to hold and say "Oops some predator bit your tail off, but not to worry, you can grow a new one". Scientists are studying TAIL REGENERATION to see if they can apply it to human limb regeneration.

10. Frogs have long TONGUES that are usually attached near the back of the jaw and folded on the base of the mouth with the tip of the tongue pointing back toward their throats. Their tongues can be flipped out very rapidly and accurately in order to catch an insect or other tasty treat. Mucus glands in the mouth produce a sticky substance that helps to catch prey. **A Birthday party noise maker that unrolls makes a great frog tongue.**

11. Amphibians are COLD-BLOODED which means that their body temperature matches the temperature of their surroundings. They don't have to expend a lot of energy trying to keep warm like warm-blooded animals, so they are less active when it's cold and don't have to eat as much. **A Digital Thermometer can be used to illustrate this.**

12. Frogs and salamanders have TEETH! The small, cone-like teeth on the upper jaw are called maxillary teeth. In addition some amphibians have vomerine teeth which are located on the roof of the mouth and used for holding prey. **Fake rubber or plastic teeth will do nicely.**

13. Wood frogs' LIVERS PRODUCE GLUCOSE which circulates to the organs in the body, like antifreeze in your car circulates to the different parts of the engine. Glucose has a higher freezing point than water, so it prevents a frog's organs from freezing. Ice crystals might form in the body cavity but its organs are protected by glucose "antifreeze". Wood frogs become little frog ice cubes, but because their organs and other cells are protected, they thaw in the spring and hop away. **Try using a jug of Antifreeze!**

Declines and Deformities

Amphibians are the caretakers of the earth.
They are the indicators, the messengers.

Frogs, toads, newts and salamanders first appeared on earth about 400 million years ago, and adapted to occupy many different habitats – wetlands, forests, deserts and prairies. Over time, new species evolved to take the place of those that became extinct. Scientists estimate there are over 5000 species of amphibians on the planet today. Until recently, your chance of seeing a frog, toad or salamander was pretty high – they were everywhere! But now they appear to be big trouble. Amphibians are disappearing worldwide and no one is sure exactly why.

Amphibians are on the decline all over the world – in cities and rural areas, in rainforests and wetlands, in developed and undeveloped areas alike. Some areas that used to have healthy populations now have few if any amphibians. And some species, like Costa Rica's Montaverde golden toad and Australia's Gastric brooding frog are now believed to be extinct.

And while scientists study possible causes – habitat loss, global climate change, increased ultraviolet radiation, chemical and biological contaminants, and predation by invasive species – they still find more questions than answers. For example, amphibian declines are happening in surprising places – some of the biggest declines are happening in protected areas, like national parks and remote wilderness areas, rather than obvious places like cities or suburbs.

Scientists suspect declines are due to a variety of causes, rather than one big reason. For example, some scientists hypothesize that increased ultraviolet radiation may be weakening anurans' immune systems, making them more vulnerable to parasites and disease. Researchers now believe that multiple causes like these and others may be responsible for a large number of worldwide declines.

And if amphibians really are messengers, like canaries in the coal mine,
should we be paying closer attention? What message might they have for us?

KIDS MAKE A DIFFERENCE!

When it comes to frogs, scientists owe a lot to kids! While on a field trip, a class of Minnesota 8th graders observed far fewer frogs than they expected, and noted many of the frogs they did see were deformed. They shared their observations with scientists, and spurred a world-wide investigation of amphibian populations!

You already have many of the tools you need to help amphibian populations – your curiosity, interest and enthusiasm will get you started. And by participating in activities in this curriculum, you'll learn about what's happening around the world.

In the meantime, here are some things you can do today!

1. Surf the web to find out more about amphibians in general, or in Southeast Alaska. Learn how to identify them by sight and sound. Then get outside and start looking, listening and learning!

2. Create frog-friendly gardens. Frogs like all sorts of plants and a well-watered yard – not a problem in southeast Alaska! Research the garden plants and products you use to make sure they are non-toxic and don't harm frogs or the foods they eat.

3. Don't pour oils or detergents down the drain, especially if they drain into local streams, rivers and wetlands. These are important amphibian habitats. Always dispose of chemicals correctly. If you aren't sure how to do this, call your local garbage hauler or city hall.

4. Keep ponds and stream litter free. Organize classmates or neighbors to clean up the waterways in your community to protect important amphibian habitat.

5. Share what you know. Teach others about amphibians and the trouble they might be in. The more we know, the more we can do to help.

A note about collecting live animals:

- Once an animal has been collected and kept in a classroom aquarium, it should NOT be released into the environment.
- Because many species require lots of space, confining them to a small aquarium for the rest of lives would be unfair.
- Toads and newts also contain glands that secrete poison. Rough-skinned newts are among the most poisonous animals in the world – be sure to wash your hands after handling.
- Finally, and most importantly, because there are so few frogs and toads in Juneau, collecting even a few could greatly impact an already declining population.

Science Activity: **Why do these amphibians look so weird?**

Introduction:

In this two part online activity, students will be introduced to the mystery of amphibian deformities. In the first part, students will learn about the scientific method. In the second, they will learn how scientists use the scientific method to discover potential causes for amphibian deformities. The websites you will use are full of information, including pictures of deformed frogs that will surely capture students' attention.

Objectives:

1. Students will be able to describe the scientific method.
2. Students will be able to name the four probable causes for frog deformities.

Materials:

1. Website: www.frogweb.gov
2. computer and computer projector

Procedure:

1. Before sharing with students, preview the <www.frogweb.gov/> website and follow links to Deformed Amphibian Research at Hartwick College. You may find this site directly by going to < http://info.hartwick.edu/biology/def_frogs/index.html>.

2. Open <www.frogweb.gov/> with students to introduce them to the scientific method, as well as research related to amphibian deformities.

3. Follow links to Deformed Amphibian Research at Hartwick College.

Assessment:

1. Students identify a simple problem and apply the scientific method to solve it.

2. Students choose one of the four causes for frog deformities and explore, verbally or in writing, whether that may be responsible for amphibian declines in southeast Alaska.

National Science Education Standards:

Content Standard A:

- Develop abilities necessary to do scientific inquiry
- Develop understandings about scientific inquiry

Content Standard G:

- Develop understanding of the nature of science

Alaska Content Standards:

Science A(1)
Science E(1)

Juneau School District Core Content:

Inquiry (5th):

How can we gather data to provide us with an explanation to our questions?

Life and Human Biology (6th – 8th):

Human Impacts: How do human activities affect our environment?

References:

Deformed Amphibian Research at Hartwick College. Sessions, Stanley K. Hartwick College. 16 March 2004 <http://info.hartwick.edu/biology/def_frogs/index.html>.

FrogWeb: Amphibian Declines and Deformities. National Biological Information Infrastructure. Center for Biological Informatics for the US Geological Survey. 16 March 2004 <www.frogweb.gov/>.

Science Activity: **The Case of the Missing Anurans**

Introduction:

This activity was adapted from the Center for Global Environmental Education. Visit their website at www.cgee.hamline.edu/frogs/teacher/index.html.

Objectives:

1. Students will be able to describe the environmental changes that may affect anurans.

2. Students will be able to state at least one hypothesis to explain the large change in anuran population size.

Materials:

1. paper
2. pencils
3. copies of CLUE sheets for each group (worksheets provided)
4. presentation materials

Procedure:

1. Split students into small groups, representing a team of herpetologists and other scientists gathered to discuss declining anuran populations around the world.

2. Read "BACKGROUND: The Case of the Missing Anurans" to class.

3. Give each a team a CLUE to read, research and form the basis of a ***hypothesis*** designed to explain potential causes of anuran declines. A hypothesis is a credible idea to be tested in an experiment, as opposed to a ***theory***, which is a concept established and supported by experimentation.

4. Encourage each team in designing a controlled experiment which could be done by scientists in a laboratory or in the field to tests their hypothesis.

5. Allow each team presents their hypothesis and experimental design to the group. Presentations should be creative and serve as a basis for comparing ideas, noting similarities and differences in data, hypotheses and experimental design.

Assessment:

1. Students examine the information presented in their CLUE.

2. Students research and critically evaluate additional information by exploring books, journals, and internet sources.

3. Students develop and present their ideas to class.

Extensions:

1. Research local amphibian populations to determine whether they are steady, declining or increasing. Encourage students to interview parents, grandparents and other adults to see if they've noticed a change in amphibian populations. Ask them to hypothesize why.

2. Help migrating amphibians as they cross roads and other obstacles on their way from wintering grounds to spring breeding ponds. Consider organizing your class to help critters cross the road.

3. Look for amphibians in myths, legends, fairytales and folklore. Why do they appear in so much art and literature? Are they portrayed in a positive or negative way? Are the characteristics attributed to them based on fact or fiction? See if you can write your own myth, legend or fairytale about amphibians.

National Science Education Standards:

Content Standard A:

- Develop abilities necessary to do scientific inquiry
- Develop understandings about scientific inquiry

Content Standard G:

- Develop understanding of the nature of science

Alaska Content Standards:

Science A(1)
Science E(1)

Language Arts A(1, 4,6), C(5)

Juneau School District Core Content:

Science:

Inquiry (5th): How can we gather data to provide us with an explanation to our questions?

Life and Human Biology (6th – 8th):

Human Impacts: How do human activities affect our environment?

References:

A Thousand Friends of Frogs. 1999. Center for Global Environmental Education. Hamline University Graduate School of Education. 16 March 2004 <www.cgee.hamline.edu/frogs/teacher/index.html>.

Note: This website contains an extensive, though possibly dated, bibliography.